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Leather making potentiality of cattle hides obtained from fallen (dead) and slaughtered animals. Part I

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LEATHER MAKING POTENTIALITY OF CATTLE HIDES OBTAINED FROM FALLEN (dead) AND SLAUGHTERED ANIMALS. PART I*

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The leather making property of hides from fallen animals (fallen hides) for full chrome shoe upper leather was investigated and compared with that of hides from slaughtered animals (slaughtered hides). Random samples of fallen and slaughtered cattle hides were collected from two different regions of India. The quality of fallen hides received from Flaying and Carcass Utilisation Centres would appear poorer than that of slaughtered hides because of factors such as considerable delay in flaying and curing and improper handling but the selection of the finished leather compared well with that of raw selection. On the other hand, assessment of finished leathers produced from slaughtered hides was found to go down due to appreciable flaying defects and tick, pock and vein marks.

On an average, the slaughtered hides and leathers made from slaughtered hides had a slightly higher tensile strength and lower elongation than the fallen hides and leathers made from fallen hides. Grain crackiness and bursting strength of the leathers produced from fallen hides of Bombay region were low in comparison with those of slaughtered hides from the same region, but it was not so in the case of fallen hides from Calcutta region. Chemical analysis of raw hides and finished leathers did not show any marked difference between the slaughtered and fallen hides.

Introduction

Cattle hides are obtained as by-products of slaughter houses in many countries, while a small percentage is obtained from fallen animals in some countries. In Denmark, hides from fallen animals (fallen hides) are marketed along with the hides from slaughtered animals (slaughtered hides) depending on their quality but, in England, fallen hides are marketed separately and they fetch a much lower price than slaughtered hides. In India, about 80% of the available cattle hides are obtained from fallen animals and are marketed according to their quality with the slaughtered hides. Cattle may die suddenly due to

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certain diseases when the quality of the hide may not be deleteriously affected but when the animal dies a natural death due to old age, the quality of the hide is generally poor. Even after the death of the animal, the hide may not be flayed and cured in time or poorly cured. It is quite apparent that the quality of hides obtained from such animals will be seriously affected and the leather making potentiality of each hide will entirely depend on the extent to which it has suffered deterioration and damage before it is actually processed. The effect of delay in cure on the quality of raw hide and consequently on leather quality has been studied by Hauck and Lollar.[1] Often it is considered that leathers produced from fallen hides are of poor quality but no work has been reported investigating the quality of fallen hides obtained from different sources and their relationship to the quality of the leathers produced in comparison to that of slaughtered hides. In the present work, fallen hides were collected from Flaying and Carcass Utilisation Centres, where the dead animals are brought and flayed and the hides are cured. It was expected that hides collected from such centres would provide better representation of the quality of available fallen hides.

Materials and methods

Thirty-two fallen cattle hides were obtained from the Flaying and Carcass Utilisation Centres near Bombay and Calcutta and thirty-six slaughtered cattle hides were collected from slaughter houses in Bombay and Calcutta. It may, however, be mentioned that in Indian slaughter houses, young cattle, particularly cows, are not slaughtered. In Bombay Flaying and Carcass Utilisation Centre, all the fallen hides could not be collected at a time due to non-availability; the hides were thus salted and stored in the Centre for considerably a longer period before sending them to the Central Leather Research Institute at Madras. The slaughtered and fallen hides were examined after they were received in the Institute.

Assessment of raw hides

(i) *Visual assessment*: Visual assessment of the hides was made on the basis of (a) general appearance, (b) flay cuts and holes, (c) substance, (d) flankiness, (e) sores, scratches and other grain damages, and (f) curing defects e.g., hair-slip and red-heat. Hides were graded into four categories i.e., first, second, third and rejection quality.

(ii) *Histological assessment*: A sample from each hide was taken from identical positions, washed well with water and then fixed in formol saline. Hide sections were cut by a freezing microtome, stained with different staining agents and then examined in a microscope for the following: (a) adherence of epidermis to corium, (b) cells of grain layer, (c) compactness of the fibre structure, (d) thickness of the fibres, (e) substance (thickness of the hide) and (f) extent of bacterial penetration.

A maximum of 8 points and a minimum of 2 points were given for each item and the average of these values was considered as indicative of the quality of the hide. Histologically the hides were classified into four categories: very poor, poor, fair and good.

Physical properties of raw hides

Samples were taken from the butt area of the hide in a direction perpendicular to the backbone (Fig. 1), fleshed and washed and dehydrated in increasing concentrations of acetone for a period of 4-5 days. Tensile strength and elongation of the acetone dried hide samples were determined in a tensile strength testing machine.[2]

Chemical analysis

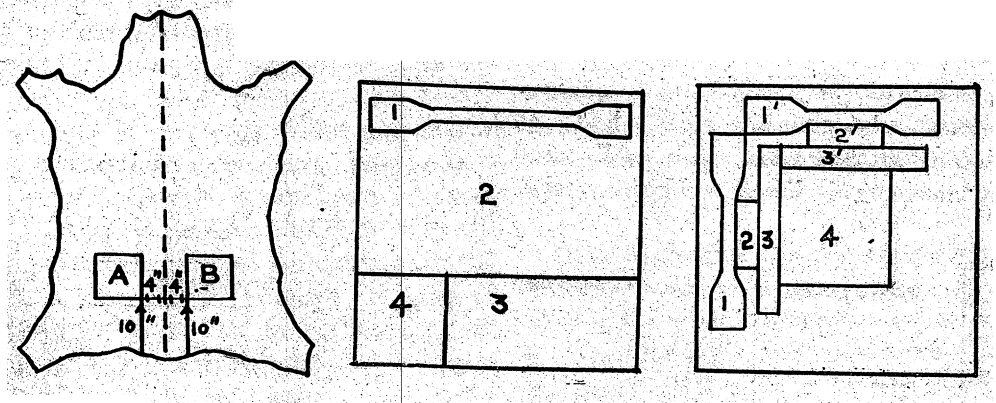
Samples taken from each hide were cut into small squares (5 mm. side). 10 g. of the samples was taken for moisture determination and 5 g. of the samples for fat estimation. Moisture was determined by the ALCA method.[3] During the fat determination, the hide samples were first hydrolysed with 6*N* HCl and then extracted with chloroform.[4] Ash was determined by heating 5 g. hide samples in a muffle furnace at about 700°C. For hydroxyproline estimation, hide pieces were unhaired with a safety razor and the adhering flesh layer was removed. They were washed well with distilled water to free them from salt and then dehydrated with acetone. The Neuman and Logan method[5] was followed in estimating hydroxyproline.

Assessment of leather quality

All the hides were tanned and finished into chrome tanned shoe upper leather. They were taken in a number of experimental lots with both the slaughtered and fallen hides in each lot.

The efficiency of tanning of the hides was adjudged from visual assessment of the quality of the leather, physical properties and chemical properties of the leathers.

Visual assessment of leather quality was made depending on general appearance, smoothness of grain, temper, tightness and grain break, grain crackiness, and fullness of shanks.



A. Hide

B. Leather

A

1 — Tensile strength, 2 — Chemical analysis,
3 — Hydroxyproline, 4 — Histological assessment

B

1, 1′ — Tensile strength, 2, 2′ — Stitch tear strength,
3, 3′ — Tongue tear strength,
4 — Grain cracking and bursting strength

Fig. 1. Sampling positions in hide and finished leather

Leathers were classified into first, second, third and rejection quality, but this classification might differ from commercial grading of the leathers.

The physical properties of the leathers taken from the positions shown in Fig. 1 were determined after proper conditioning of the samples.[6] Tensile strength, elongation at break, stitch tear strength and tongue tear strength were determined in a tensile strength testing machine and grain crack and bursting strength were determined in a Mullen bursting strength tester.

Chemical analyses of the leathers e.g., moisture, hide substance, Cr_2O_3 and fat were carried out according to standard procedures.

Results

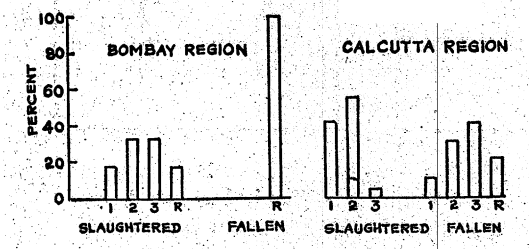
The qualities of the slaughtered and fallen hides as assessed by visual inspection are reported in Fig. 2.

Comments on raw hide quality: Bombay slaughtered hides had no adhering fat and were clean, well cured but mechanical damages like scratches and abrasion on the hair side affected the hides. The fallen hides were of poor quality showing easy hair-slip and suffered from considerable grain damage. Fallen hides were also partially dried out.

Calcutta slaughtered hides were clean, well cured, had no excess flesh, but were damaged due to flay cuts. Many of the fallen hides showed slight hair-slip and retained slightly more adhering flesh. Both the slaughtered and fallen hides possessed large flank areas.

It is evident from Fig. 2 that the fallen hides collected from the Flaying and Carcass Utilisation Centres are poor in quality compared to slaughtered hides.

Histological assessment values of the slaughtered and fallen hides are given in Table 1. According to histological assessment, 24 slaughtered hides are classified as good and 12 as fair. The classification of the fallen hides is as follows: good-9, fair-11, and poor-12 hides. The tensile strength and elongation at break of the acetone dried hides are given in Table 2.



1 — first quality, 2 — second quality, 3 — third quality, R — rejection quality

FIG. 2. Visual assessment of slaughtered and fallen hides

Table 1

HISTOLOGICAL ASSESSMENT OF SLAUGHTERED AND FALLEN HIDES

	No. of hides	
	Slaughtered	Fallen
Bombay Region		
Good	9	—
Fair	3	4
Poor	—	8
Very Poor	—	—
Calcutta Region		
Good	15	9
Fair	9	7
Poor	—	4
Very Poor	—	—

PHYSICAL PROPERTIES OF ACETONE DRIED SLAUGHTERED AND FALLEN HIDES

	Slaughtered hides			Fallen hides		
	Maximum	Minimum	Average	Maximum	Minimum	Average
Bombay Region						
Tensile strength (lb./sq. inch)	6901	4423	5908	6901	4054	5429
Elongation (%)	60	44	54	86	45	60·5
Strength-elongation product	401640	238842	317487	430430	227024	327357
Calcutta Region						
Tensile strength (lb./sq. inch)	8991	4098	6794	6530	3053	4892
Elongation (%)	81	27	55	82·5	40	58
Strength-elongation product	541080	110646	376888	458475	145692	277780

The tensile strength and elongation data do not give much indication about the quality of the individual hides. On an average, the tensile strength of the slaughtered hides seems to be higher than that of the fallen hides and this is more prominent in Calcutta hides. Percent elongation, on the other hand, appears to be lower in slaughtered hides. Average strength-elongation products do not differ much in Bombay slaughtered and fallen hides but in Calcutta hides, the strength-elongation product is appreciably higher in the case of slaughtered hides. Data on chemical analysis of the hides are presented in Table 3.

Moisture and ash content of all the slaughtered hides and Calcutta fallen hides appear to be within the range of normal well cured hides. Bombay fallen hides are partially dried up and the ash, or, in other words, the salt content in some of the hides is quite low. Fat and hydroxyproline content in slaughtered and fallen hides, on an average, do not vary to any great extent.

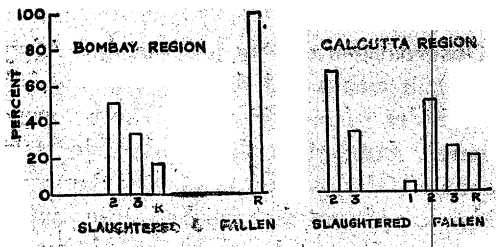
Observations during processing: After liming, it was noted that most of the fallen hides from Bombay area were severely damaged with considerable grain damage. Of these four heavily damaged hides could not be finished into upper leathers. It was, however, noted during blue selection that only about 53% of the slaughtered hides and about 31% of the fallen hides were suitable for finishing into full chrome shoe upper leathers.

Table 3

CHEMICAL ANALYSIS OF SLAUGHTERED AND FALLEN HIDES

	Slaughtered hides			Fallen hides		
	Maximum	Minimum	Average	Maximum	Minimum	Average
Bombay Region						
Moisture (%)	45·04	40·41	43·87	41·4	32·78	36·35
Ash (%)	16·97	12·84	14·58	16·27	10·34	13·27
Fat (%)	8·46	4·66	6·13	9·46	2·80	5·22
Hydroxyproline (% on salt & moisture free wt.)	11·63	10·2	10·73	11·99	9·75	10·42
Calcutta Region						
Moisture (%)	44·22	38·51	42·0	47·0	31·63	39·28
Ash (%)	16·34	12·25	14·68	18·99	13·31	15·19
Fat	7·02	3·01	5·7	6·99	3·27	5·4
Hydroxyproline (% on salt & moisture free wt.)	12·8	9·7	11·4	12·3	9·4	10·6

Visual assessment of the quality of finished leathers is presented in Fig. 3.



1—first quality, 2— second quality
3—third quality, R—rejection quality

FIG. 3. Visual assessment of finished leathers made from slaughtered and fallen hides

Comments on leather quality: It is noteworthy that out of 36 slaughtered hides no single piece was graded into first quality; 22 pieces were graded as seconds, 12 as thirds and 2 as rejections. The quality of the leathers from Bombay slaughtered hides is found to be affected due to coarser break, lack of suppleness and presence of vein marks. Two hides yielded rejection quality leathers because of poor substance, and scar, tick and vein marks.

Slaughtered hides from Calcutta region were found to be degraded in quality due

to deep flay cuts, tick and vein marks. Leathers from both slaughtered and fallen hides of this region had more shank areas.

FIG. 4. Surface photograph of a rejection quality leather produced from fallen hide

All the fallen hides from Bombay region were graded into rejection quality. Some of these leathers were otherwise good except for severe grain damage (Fig. 4). Such grain damages could possibly be avoided by minimising the delay in cure and following more effective curing. Fallen hides from Calcutta region were much better than Bombay hides. These leathers were free from severe grain damages and flay cuts but were deteriorated in quality due to such defects as tick marks, blisters and poor shanks. Out of 32 pieces of leathers from fallen hides, one piece was graded as first quality, 10 pieces as seconds, 5 pieces as thirds and 16 pieces as rejection quality. Finished leather selection thus supports the previous observation that fallen hides collected from Flaying and Carcass Utilisation Centres are comparatively poorer in quality than the slaughtered hides for making full chrome shoe upper leathers.

The physical properties of the leathers from slaughtered and fallen hides are presented in Table 4.

The physical properties of most of the slaughtered and fallen hides may be considered as acceptable for normal quality chrome upper leather. Certain hides, of both slaughtered and fallen variety, have lower values for tensile strength, grain crackiness and bursting strength. Here again, it may be noted that the tensile strength values of the leathers from fallen hides are comparatively lower and the elongation values higher than those for the leathers from slaughtered hides although the difference is very little in case of Calcutta hides. In leathers from Bombay region, the strength at grain crack and bursting strength are slightly less in fallen hides but they do not vary much in leathers from Calcutta hides.

The chemical analysis of the leathers both from slaughtered and fallen hides is given in Table 5.

The chemical composition of the leather from slaughtered and fallen hides does not differ significantly except that the fat content of the leathers from Bombay fallen hides is slightly higher than that of leathers from Bombay slaughtered hides. This may be due to considerable grain damage in the hides caused by bacterial action which has facilitated more fat uptake.

Table 4

PHYSICAL PROPERTIES OF LEATHERS MADE FROM SLAUGHTERED AND FALLEN HIDES

		Slaughtered hides			Fallen hides		
		Maximum	Minimum	Average	Maximum	Minimum	Average
Bombay Region							
Tensile strength (lb./sq. inch)	⊥	5928	2846	4193	3998	2629	3123
	=	4249	1954	3067	4176	1463	2766
Elongation (%)	⊥	51·0	37·5	45·0	86·0	47·5	63·0
	=	51·0	35·0	43·0	62·5	41·0	50·0
Stitch tear strength (lb./inch)	⊥	1456	1016	1303	1170	970	1112
	=	1492	1016	1216	1310	910	1109
Tongue tear strength (lb./inch)	⊥	307	176	242	296	176	233
	=	343	189	278	346	191	243
Grain crack strength (lb./sq. inch/inch)		15663	4638	11149	12505	3712	6501
Bursting strength (lb./sq. inch/inch)		19538	4638	13741	16595	6531	10201
Strength-elongation-product (lb.sq. inch)	⊥	287508	106725	189102	309845	147750	200445
	=	211497	80505	133651	189200	68127	135439
Calcutta Region							
Tensile strength (lb./sq. inch)	⊥	4622	2337	3588	4640	1870	3336
	=	4580	2337	3366	4585	1963	3130
Elongation (%)	⊥	75	37	51	77	31	54
	=	59	37	46	56	34	43
Stitch tear strength (lb./inch)	⊥	1714	1143	1420	1613	867	1362
	=	1664	864	1317	1478	775	1255
Tongue tear strength (lb./inch)	⊥	508	226	399	470	242	338
	=	508	216	300	475	173	300
Grain crack strength (lb./sq. inch/inch)		15702	5362	9916	22000	11618	11157
Bursting strength (lb./sq. inch/inch)		21844	16160	14639	22000	8313	13550
Strength-elongation-product (lb./sq. inch)	⊥	264825	14160	185117	278922	57970	180939
	=	270220	102878	157349	194876	68102	132034

Table 5

CHEMICAL ANALYSIS OF FINISHED LEATHERS PRODUCED FROM SLAUGHTERED AND FALLEN HIDES

	Slaughtered hides			Fallen hides		
	Maximum	Minimum	Average	Maximum	Minimum	Average
Bombay Regio						
Moisture (%)	12·57	11·27	11·9	12·97	11·33	12·04
Cr_2O_3 (%)	3·91	3·61	3·75	3·99	3·70	3·66
Fat (%)	4·65	3·34	3·84	4·51	3·66	4·10
Hide substance (%)	65·32	63·53	64·74	64·85	63·26	64·54
Calcutta Region						
Moisture (%)	15·83	13·77	14·43	15·48	13·99	14·59
Cr_2O_3 (%)	4·19	3·50	4·10	4·26	3·97	4·11
Fat (%)	4·34	3·50	3·92	4·41	3·28	3·88
Hide substance (%)	65·89	62·02	64·87	65·46	63·03	64·23

Discussion

Previous investigations in the field of raw hides and skins have revealed that it is hardly possible to depend on any particular method of assessing the quality of raw hide in order to find out its leather making potentiality. In the present work, therefore, hides are examined visually and histologically for their quality and some physical and chemical characteristics determined.

According to visual assessment, the slaughtered hides are classified into the following grades: 1st quality — 33·33%, 2nd quality — 47·22%, 3rd quality — 13·89% and rejections — 5·56%; the fallen hides are graded as: 1st quality — 6·25%, 2nd quality — 18·75%, 3rd quality — 25·0% and rejection quality — 50%. It is thus apparent that slaughtered hides obtained from slaughter houses are, on the average, better raw materials than fallen hides available in Flaying and Carcass Utilisation Centres. It is, however, worthy of note that only one third of the slaughtered hides is graded into 1st quality and some of the slaughtered hides are even considered as rejection. Two factors mainly responsible for the devaluation of the slaughtered hides are flaying defects and restrictions on cattle slaughter; mostly aged animals are slaughtered in slaughter houses and the hides are generally damaged by parasites, diseases and sores.

Fallen hides are appreciably free from flaying defects but are degraded due to damages caused by delay in flaying and

curing, improper cure and careless handling. Fallen hides obtained from Bombay region are severely damaged in the grain probably due to these reasons.

Like visual assessment, histological assessment also reveals that, in general, the slaughtered hides are superior in quality to the fallen hides.

Table 3 shows that the average tensile strength of the slaughtered hide is slightly higher and average elongation slightly lower than that of fallen hides. The strength-elongation product gives the work done to break the sample. The average strength-elongation product seems to be slightly higher in acetone dried samples of slaughtered hides but practically no difference is noted between finished leathers produced from slaughtered and fallen hides.

Chemical analysis of the hides does not give much indication about the quality of individual hides. In a properly cured hides the moisture present is to be saturated with salt. Although most of the slaughtered and fallen hides satisfy this criterion of a good cured hide, some fallen hides obtained from Bombay are cured probably with inadequate quantities of salt and thus subjected to severe deterioration in quality. Hydroxyproline content of the fallen hides, on an average, appears to be slightly less than that of slaughtered hides.

It is thus clear that the physical properties of the hides have no relation to the assessment of quality as practised by the trade. This is because the present method of assessment is based on visual observation of defects which are only found at certain points on the hides whereas physical properties are determined on samples taken from the prescribed regions, which may not contain these detects. A real deterioration in the whole of the hide would certainly show up in the strength and elongation properties whereas a hide without visible defects need not necessarily yield a good leather.

This is confirmed by the result that although 12 slaughtered hides have been classed into 1st quality by visual inspection, none of them has turned out as 1st quality after finishing into full chrome upper. Considerable damage due to flay cuts, pock and tick marks, prominent vein marks and other defects that remained unidentified during visual inspection is mainly responsible for such degradation of leather quality.

An example of how hide quality is tied up with physical properties is shown by the lower tensile strength and higher elongation of fallen hides as compared to slaughtered hides of the Bombay region which point to a higher degree of deterioration of fallen hides and this is reflected in the leathers made from these two varieties of hides, the tensile strength being lower and the elongation at break being higher in the fallen hides. These observations on the physical properties are in conformity with the observation that the fallen hides of the Bombay region were not cured or preserved as well as the slaughtered hides. In the case of the hides of the Calcutta region, the differences in the tensile strength and elongation values are not as much as in the Bombay region and this could be attributed to the better curing of the fallen

hides effected in the Calcutta region. Similar observations hold good for the other physical properties.

After a critical study of the leathers obtained from slaughtered hides it was noted that 2 pieces are upgraded and 20 pieces degraded, the rest being of same quality as that of raw selection.

In case of fallen hides, 5 pieces are found to be upgraded after finishing, 4 pieces are degraded in quality and the rest 23 pieces follow the same raw assessment. This shows that the leather making potentiality of fallen hides remains unaffected provided the condition of the raw hide is found acceptable for its quality comparable to slaughtered hides.

Though the limitations of the assessment values for different grades of hides have been arbitrarily chosen, the histological assessment of the raw hides appears to be moderately comparable to the finished leather selection. 6 pieces of leathers from slaughtered hides are found to be upgraded, 9 pieces are rated as lower grades and 21 pieces are graded into the same raw selections. On the other hand, 7 pieces of leather from fallen hides are upgraded, 2 pieces degraded and 23 pieces follow the raw selection. It may also be mentioned that four fallen hides from Bombay region that are found severely damaged and unsuitable for finish have very low assessment values.

No appreciable difference can be seen between leathers from slaughtered and fallen hides in respect of other physical properties.

Chemical analyses of the leathers do not indicate any difference between the qualities of the leathers from fallen and slaughtered hides

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